

**PART 1**      **GENERAL**

**1.1**      **DESCRIPTION**

- .1      This section specifies requirements for the supply, placing, finishing, protecting and curing cast-in-place concrete for mooring cleat blocks, reinforced concrete decks, slab on grade and pre-cast launch way panels.

**1.2**      **RELATED REQUIREMENTS**

- .1      Section 03 10 00 – Concrete Forming and Accessories
- .2      Section 03 20 00 – Concrete Reinforcing
- .3      Section 03 41 00 – Precast Structural Concrete

**1.3**      **MEASUREMENT FOR PAYMENT**

- .1      Reinforced Concrete Deck -250 mm (min): Supply and installation of reinforced concrete deck to be measured in square meters (m<sup>2</sup>) calculated from the actual field measurements mooring cleat pedestals and coping. Contractor to provide all plant, equipment, materials and labour including concrete, reinforcing steel, isolation and control joints. Actual deck thickness varies to accommodate specified slope, costs for which shall be included in the unit price.
- .2      Concrete panels – Launchway: Supply and installation of the pre-cast concrete panels for the launchway will be measured in square metres (m<sup>2</sup>) calculated from the actual field measurements, excluding the area occupied by the coping. Include all plant, equipment and labour in the unit price. See Section 03 41 00 – Precast Structural Concrete.
- .3      Slab on Grade – Launchway: Supply and installation of reinforced concrete deck to be measured in square meters (m<sup>2</sup>) calculated from the actual field measurements. Include all plant, equipment and labour in the unit price.
- .4      Cleat Blocks: No measurement for payment to be made under this section. Include costs incidental to unit price for Type “B1” mooring cleats.
- .5      Measure cast-in-place concrete in cubic metres calculated from neat dimensions as indicated or authorized in writing by Departmental Representative.
- .6      Payment at the unit price will be full compensation for all material, labour, equipment, plant, divers and other services necessary to complete the work.
- .7      No separate payment will be made for formwork, reinforcement, cement, aggregates, admixtures or other accessories necessary to complete the work.
- .8      Concrete placed beyond dimensions indicated will not be measured.

- .9 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.
- .10 Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.
- .11 No deductions will be made for volume of concrete displaced by reinforcing steel, structural steel, or piles.
- .12 Supply and installation of anchor bolts, nuts and washers and bolt grouting will not be measured but considered incidental to work.

#### **1.4 REFERENCES**

- .1 Abbreviations and Acronyms:
  - .1 Cement: hydraulic cement or blended hydraulic cement (XXb - where b denotes blended).
    - .1 Type GU or GUb - General use cement.
    - .2 Type MS or MSb - Moderate sulphate-resistant cement.
    - .3 Type MH or MHb - Moderate heat of hydration cement.
    - .4 Type HE or Heb - High early-strength cement.
    - .5 Type LH or LHb - Low heat of hydration cement.
    - .6 Type HS or HSb - High sulphate-resistant cement.
  - .2 Fly ash:
    - .1 Type F - with CaO content less than 8%.
    - .2 Type CI - with CaO content ranging from 8 to 20%.
    - .3 Type CH - with CaO greater than 20%.
  - .3 GGBFS - Ground, granulated blast-furnace slag.
- .2 Reference Standards:
  - .1 ASTM International
    - .1 ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete.
    - .2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - .3 ASTM C494/C494M-, Standard Specification for Chemical Admixtures for Concrete.
    - .4 ASTM C1017/C1017M- Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
  - .2 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-51.34-Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
  - .3 CSA International

- .1 CSA A23.1/A23.2 Concrete Materials and Methods of Concrete Construction/ Methods of Test and Standard Practices for Concrete.
- .2 CAN/CSA-A23.5, Supplementary Cementing Materials.
- .3 CAN3-A266.1, Air-Entraining Admixtures for Concrete.
- .4 CAN3-A266.2, Chemical Admixtures for Concrete.
- .5 CAN3-A266.4, Guidelines for the Use of Admixtures in Concrete.
- .6 CAN/CSA A363, Cementitious Hydraulic Slag.
- .7 CSA A283, Qualification Code for Concrete Testing Laboratories.
- .8 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

## **1.5 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 At least 2 weeks prior to beginning Work, submit to Departmental Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
  - .1 Portland cement.
  - .2 Blended hydraulic cement.
  - .3 Supplementary cementing materials.
  - .4 Grout.
  - .5 Admixtures.
  - .6 Aggregates.
  - .7 Water.
  - .8 Joint filler.
  - .9 Joint Sealant.
- .3 Provide testing results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .4 Concrete pours: Provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken.
- .5 Concrete hauling time: Provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.
- .6 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

## **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance in accordance with Section 01 45 00 – Testing and Quality Control.

- .2 Provide Departmental Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
- .3 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements and will comply with CAN/CSA-A23.1.
- .4 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.
- .5 Minimum 2 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
  - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.
  - .6 Formwork removal.
  - .7 Joints.
  - .8 Equipment List
- .6 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete.

#### **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Store materials to prevent contamination or deterioration.
- .2 Provide adequate storage facilities for materials to ensure a continuous supply of these materials during batching operations.
- .3 Store cement in weather tight facility.
- .4 Delivery and Acceptance Requirements:
  - .1 Concrete hauling time: Deliver to site of Work and discharged within 120 minutes maximum after batching.
    - .1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
    - .2 Deviations to be submitted for review by Departmental Representative.
  - .2 Concrete delivery: Ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

#### **1.8 WASTE MANAGEMENT AND DISPOSAL**

- .1 Use trigger operated spray nozzles for water hoses.

- .2 Designate a cleaning area for tools to limit water use and runoff.
- .3 Carefully coordinate the specified concrete work with weather conditions.
- .4 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .5 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .6 Choose least harmful, appropriate cleaning method which will perform adequately.

## **PART 2      PRODUCTS**

### **2.1      DESIGN CRITERIA**

- .1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in section 2.4.

### **2.2      PERFORMANCE CRITERIA**

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance.

### **2.3      MATERIALS**

- .1 Portland Cement and supplementary cementing materials: to CSA A3000, CSA A3001, Type GU.
  - .1 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCM's) Mix, as percentage.
- .2 Blended hydraulic cement: Type GUB to CSA A3001.
- .3 Supplementary cementing materials: to CSA 3000, maximum 20% Type F fly ash, maximum 10% silica fume by mass of total cementitious materials.
- .4 Water: to CSA A23.1 (sea water not to be used).
- .5 Aggregates: to CSA A23.1/A23.2.
  - .1 Coarse aggregate to be normal density.
- .6 Admixtures:
  - .1 Air entraining admixture: to CAN3-C260.
  - .2 Chemical admixture: to ASTM C494/C494M. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
  - .3 Shrinkage-reducing admixture (SRA): to CAN3-A266.2.

- .7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
  - .1 Compressive strength: 50 MPa at 28 days.
  - .2 Net shrinkage at 28 days: maximum 0.04 %.
- .8 Non-premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 50 MPa at 28 days.
- .9 Curing compound: curing compounds are not to be used.
- .10 Bonding Agent: Latex emulsified to the approval of the Departmental Representative.
- .11 Pre-molded joint fillers:
  - .1 Sponge rubber: to ASTM D1752, Type 1, flexible grade.

## **2.4 MIXES**

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.
  - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
  - .2 Provide concrete mix to meet following requirements:
    - .1 Intended application: marine.
    - .2 Cement:
      - .1 Type GUb, Blended Cement (as required to meet Class C1 exposure)
    - .3 Minimum compressive strength at 28 days: 35 MPa.
    - .4 Minimum cement content: 385 kg/m<sup>3</sup> of concrete.
    - .5 Durability and class of exposure: C-1.
    - .6 Maximum water to cementing materials ratio: 0.40
    - .7 Aggregate size: 20 mm maximum.
    - .8 Density of air-dry concrete in range of 2240 kg/m<sup>3</sup> to 2400 kg/m<sup>3</sup>
    - .9 Slump at time and point of discharge: 50 to 100 mm.
    - .10 Air content: 5 to 8%
    - .11 Chemical admixtures: in accordance with CAN3-A266.4.
  - .3 Provide quality management plan to ensure verification of concrete quality to specified performance.
  - .4 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.
  - .5 Do not use calcium chloride.
  - .6 When the Contractor wishes to mix concrete on site, identify the source of aggregates and submit samples of fine and coarse aggregate to a testing

laboratory for testing and trial mixes in order to determine a suitable mix design. The testing laboratory, at the Contractor's cost, will test the trial mix for slump, air content, density and strength. The results of these tests will be submitted to the Departmental Representative to be reviewed for compliance with the specification. This review must be completed before permission to place concrete is given.

- .1 The sand, gravel, water and air entraining agent should be mixed prior to the addition of cement and water reducer.
- .2 Weigh aggregates, cement, water and admixture before batching. No alternative methods of measuring will be permitted.

### **PART 3**      **EXECUTION**

#### **3.1**      **PREPARATION**

- .1 Obtain Departmental Representative's written approval before placing concrete.
  - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
  - .1 Ensure continuous concrete delivery from plant.
  - .2 Development of cold joints not allowed.
  - .3 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete is permitted only after approval of equipment and mix.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Minimum concrete cover over reinforcing steel bars to be 75 mm.
- .7 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse conditions.
- .8 Protect previous work from staining.
- .9 Clean and remove stains prior to application for concrete finishes.
- .10 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .11 Remove all debris including sawdust, chips and any other deleterious materials from the interior of the forms.
- .12 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.

- .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .13 Do not place load upon new concrete until authorized by Departmental Representative.

### **3.2 INSTALLATION/APPLICATION**

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2. Comply with additional requirements of CAN/CSA-A23.1 for concrete exposed to seawater environments.
- .2 Formwork:
  - .1 Install and strip formwork to CAN/CSA-A23.1 and Section 03 10 00.
- .3 Sleeves and inserts:
  - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.
  - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
  - .3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.
  - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.
  - .5 Confirm locations and sizes of sleeves and openings shown on drawings.
- .4 Anchor bolts:
  - .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
  - .2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Departmental Representative.
    - .1 Formed holes: 100 mm minimum diameter.
    - .2 Drilled holes: 25 mm minimum diameter larger than bolts used or to manufacturers' recommendations.
  - .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
  - .4 Set bolts and fill holes with epoxy grout.
  - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .5 Drainage holes and weep holes:
  - .1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.
  - .2 Install weep hole tubes and drains as indicated.
- .6 Control Joints:



- .1 Construct control joints in locations shown on drawings or directed by Departmental Representative.
- .2 All joints will be centered over a support. Joints will be made in a perfectly straight line.
- .3 Cut control joint when concrete has hardened.
- .4 Fill saw cut with joint sealer as specified.
- .7 Grout under bases using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.

### **3.3 PLACING CONCRETE**

- .1 Place and consolidate concrete to CAN/CSA-A23.1
- .2 Do not place concrete on or against frozen material.
- .3 Place concrete continuously from joint to joint.
- .4 Place concrete in a uniform heading, normal to the centerline. Limit rate of placing to that which can be finished before beginning of initial set.

### **3.4 FINISHING**

- .1 Only ACI certified or other pre-approved concrete finishers are to be utilized in finishing all concrete works. All work is to be finished to CAN/CSA-A23.1 and as specified below.
- .2 The surface will be brought to the specified level by means of darbying or bull floating which will be carried out immediately following screeding and must be completed before any bleed water is present on the surface.
- .3 Provide slope as shown on the drawings to permit proper drainage of the concrete deck.
- .4 Finish slabs to elevations indicated on drawings.
- .5 Strike off the surface with a straight edge.
- .6 Hand tamp low slump concrete with jitterbug.
- .7 Darby or bull float the surface to smooth and level the concrete.
- .8 Allow bleed water or sheen to disappear.
- .9 Float the surface by means of power and/or hand float where the concrete has hardened enough for a person to leave only slight footprints on the surface.
- .10 Do not bring water and fines to the surface by over floating. Where extra floating is required, the floating operation shall be repeated after the time interval necessary for any sheen to disappear and for concrete to set further.

- .11 Steel trowel the concrete surfaces by means and/or hand trowel. Do not leave any hard, smooth, polished or burnished surface area.
- .12 Do not bring water and fines to the surface by over trowelling.
- .13 After light interval necessary for concrete to further harden, repeat the trowelling operation.
- .14 Lightly broom surface with a soft bristle broom obtaining a fine and even textured finish with a non-slip finish. All brush strokes to be parallel across paving.
- .15 The surface shall be true and accurate to a maximum tolerance of 1 mm in 500 mm.

### **3.5 PROTECTION AND CURING**

- .1 Cure to CAN/CSA-A23.1.
- .2 Cure concrete by protecting it against loss of moisture, rapid temperature change and mechanical injury for at least seven (7) days after placement. After finishing operations have been completed, the entire surface of the newly placed concrete shall be covered by whatever curing medium is applicable to local conditions and approved by the Departmental Representative. The edges of concrete slabs exposed by removal of forms shall be protected with continuous curing treatment equal to the method selected for curing the slab and curb surfaces. Cure to CAN/CSA-A23.1. Have the equipment needed for adequate curing at hand and ready to install before actual concrete placement begins.
- .3 When air temperature is at or below 5°C or when there is a probability of its falling to that limit within 24 hours of placing (as forecast by the nearest official meteorological office) cold weather protection as per CAN/CSA-A23.1 will be provided and the following:
  - .1 Housing – Protect concrete by a windproof shelter of canvas or other material to allow free circulation of inside air around fresh touch formwork and provide sufficient space for removal of formwork for finishing. Supply approved heating equipment capable of keeping inside air at a constant temperature sufficiently high to maintain concrete at following curing temperature.
    - .1 For initial three (3) days at a temperature of not less than 15°C not more than 27°C at surface.
    - .2 Maintain concrete at 10°C for an extra four (4) days plus the initial three (3) days.
    - .3 In addition to the protective housing, the concrete must be cured as outlined in clause 3.5.2 above.

### **3.6 SURFACE TOLERANCE**

- .1 Concrete tolerance to CSA A23.1 Straightedge Method
- .2 Surface tolerance to be 8 mm under a 3 meter straight edge.

**3.7 FIELD QUALITY CONTROL**

- .1 Site tests: conduct tests as follows and in accordance with Section 01 45 00 – Quality Control.
- .2 Site tests: conduct tests as follows:
  - .1 Concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 7 and 28 days.
  - .5 Air and concrete temperature.
- .3 Minimum frequency of tests shall be as follows:
  - .1 Each test shall consist of three (3) test cylinders.
  - .2 Conduct test for first concrete pour.
  - .3 Conduct test for each 25 m<sup>3</sup> of concrete placed or fraction thereof of each day's pour, whichever is less.
  - .4 There should be at least one test conducted for each class of pour on each day.
  - .5 One (1) cylinder shall be tested at seven (7) days and two (2) tested at 28 days.
- .4 Crate cylinders and deliver to the testing laboratory within 48 hours after casting in accordance with CAN/CSA-A23.1. Contractor will pay for crating and delivery of cylinders to the laboratory.
- .5 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative in accordance with CSA A23.1/A23.2.
  - .1 Ensure testing laboratory is certified to CSA A283.
- .6 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.
- .7 Departmental Representative shall pay for costs of tests as specified in Section 01 29 83 – Payment Procedures for Testing Laboratory Services.
- .8 Testing company shall issue reports to Departmental Representative on quality of test cylinders.
- .9 Notify Departmental Representative at least seven (7) days prior to start of placing concrete. Provide for testing purposes an adequate quantity of approved test cylinders.
- .10 Contractor will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .11 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

- .12 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.
- .13 If strength tests of test cylinder for any portion of the work falls below the specified compressive strength at 28 days, the Departmental Representative reserves the right to determine the acceptability of the concrete by performing additional field testing as outlined in CAN/CSA-A23.1.
- .14 If concrete does not conform to drawings or specifications, take measures as directed to correct the deficiency. All costs of correctional measures will be at the expense of the Contractor.

### **3.8 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Provide appropriate area on job site where concrete trucks and be safely washed.
  - .2 Do not dispose of unused admixtures and additive materials into sewer systems, water bodies or other locations where it will pose a health or environmental hazard.
  - .3 Dispose of waste in accordance with applicable local, Provincial and Federal regulations.

**END OF SECTION**